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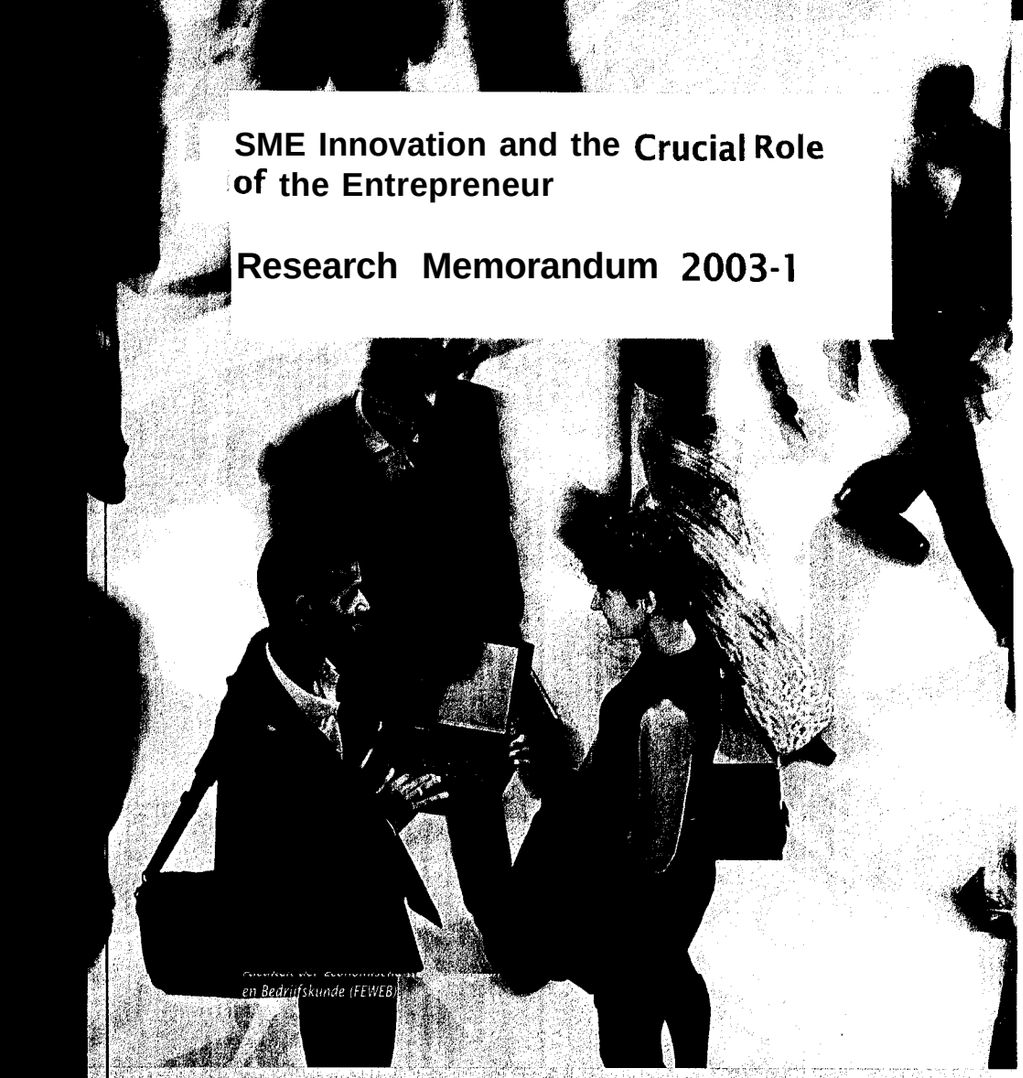
Research Memorandum 2003-1



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SME Innovation and the Crucial Role of the Entrepreneur

Research Memorandum 2003-1

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SME Innovation and the Crucial Role of the Entrepreneur

Summary

In this paper we examine the perceptions of entrepreneurs and other concemed individuals: which factors do they consider critical for success in the innovation process? From the perspective of the respondents, the entrepreneur is the most important factor in the innovation process. Intemal aspects dominate not only the list of success factors but also the top of the list. Extemal aspects appear only in the third and even the fourth clusters.

A few aspects are believed to be more important for the manufacturing sector than for the service sector. These are unique product advantages, marketing activities, pre-development, competition and collaboration. The subgroups of responding entrepreneurs and non-entrepreneurs revealed hardly any differences. Nor were there many significant scale differences.

Statistically, we may conclude that the entrepreneurs do not consider extemal circumstances very important aspects of innovation success. They have a rather egocenttic point of view, in that they place themselves and the intemal process on top (which they are in a position to influence). Extemal aspects follow much later. This attitude obviously entails a considerable risk of over-estimation.

Introduction

Schumpeter views the entrepreneur as the core of the innovation process. Extensive research from recent decades has revealed many other factors of importance for the innovation process. In this paper we examine the perceptions of entrepreneurs and other concemed individu&: which factors do they consider critical for success in the innovation process? Do they correspond with the common knowledge derived from the literature, or does their practice differ from the tbeory?

The first question we asked our respondents was whether their business revolved mainly around generating products or services. A service was defined here as being intrinsically intangible and a product as being intrinsically tangible. Innovation is related to the development and marketing of products and services that are new from the perspective of the enterprise. New can be interpreted here as a totally new product or service, new utilization possibilities of existing products/services or improvement of an existing product/service.

2. Literature review

2.1 General success factors in innovation

Montoya-Weiss and Calantone (1994) gathered and synthesized the results of empirical research on the determinants of new product performance. They identified 18 factors that capture the essence of research on these determinants. The most frequently mentioned determinants are proficiency of technological activities, proficiency of marketing activities and product advantage. The factor proficiency of technological activities indicates proficiency of product development, in-house testing of the product or prototype, trial/pilot production, production start-up, and obtaining necessary technology. Proficiency of marketing activities specifies proficiency of marketing research, customer tests of prototypes or samples, test markets/trial selling, service, advertising, distribution and market launch. Product advantages refer to customer perception of the product's qualitative superiority, cost-benefit ratio, or performance with respect to the competition.

The findings of Zirger and Maidique (1990) have revealed that managerial excellence is critical: new product development tends to be more successful if the process is planned and implemented well. Management commitment is also essential in this context. They further stress that the new products should provide real value to the customer (in terms of technical performance, lower costs, unique features, superior quality, or reliability). Strategic focus is also important. The authors recommend that firms choose projects that complement their existing technological, marketing, and organizational competencies. The market also contributes to the success of new products. The advantages of making the first move and large markets are relevant in this context.

Cooper and Kleinschmidt (1987) have concluded that product superiority is the chief factor influencing commercial success, in terms of unique features for the customer, better quality, reduction of customers' costs, innovative nature, superiority over competing products and problem-solving features. Project definition and early predevelopment activities are the most crucial steps in developing new products. Project definition can also be described in terms of a protocol consisting of a clear definition of the target market prior to the product development stage. This process may indicate customer needs, desires and preferences, the product concept, and the product specifications and requirements. Proficiency in predevelopment activities reflects initial screening, preliminary market assessment, preliminary technical assessment, detailed market study (i.e. marketing research) and business and financial analysis. Success does not result simply from situational influences but requires both marketing and technical synergies.

Craig and Hart (1992) presented a genera1 overview of the literature on research into the dynamics of new product development (a more marketing-oriented term) or innovation (a more R&D-oriented term) In their view, new product development is a necessity rather than a strategic option. There are different types or measures of product development, based on criteria such as present or new technology, existing or new product lines,

present or new marketing and current or new customer segments. The main themes in new product development research are:

- strategy: the need for new product development requires a guiding corporate strategy.
- management: successful new product development receives considerable support from top management.
- company characteristics: a decentralized, flexible structure that encourages risk-taking is the most conducive to success.
- process: the more complete the new product development process, the more successful the outcome.
- people: organizational design and project management are significant factors.
- information: dlssemination of information and the extent of communication within the organization are important for the new development process.

Yap and Souder (1994) submit that the smal1 entrepreneurial high-technology firms they studied need to adopt strategies that are very different from the ones used by large organizations to maximize their chances of success with their new product introductions. These strategies include selecting projects with high synergies and developing products that will encounter little competition and high customer need, applying high quality resources, ensuring excellent interdepartmental communications, encouraging early involvement by top management, recruiting influential product champions, and avoiding technologies that require dramatic behavioral modification among customers. Generally, these prescriptions are fairly conservative: stick with your core technologies, seek out niche opportunities, and do not overextend your abilities.

Atuahene-Gima (1996) described the results of a study comparing the innovation activities of service firms and manufacturen. While service and manufacturing firms focus on similar factors for improving innovation performance, their relative importance depends on the type of firm. The critical factor for service firms is the importance they attribute to innovation in the firm's human resource strategy, as well as management support and teamwork. Manufacturers focus primarily on the advantage and quality of product innovation.

In introducing new products, having a unique and superior product, a strong market orientation, pre-development activities (i.e. homework), a sharp and early product definition and the right people working on the project are key factors for success (Cooper, 1990). The author concludes tbat execution quality becomes crucial at a very early stage in the new product project.

Rothwell et *al.* (1974) renewed the SAPPHO (Scientific Activity Predictor from Pattems with Heuristic Options) project, which was designed to identify differences between successful and unsuccessful technological innovations. The factors that proved the most important to success were the ones conceming need satisfaction. User needs must be determined and met and should be monitored throughout the course of the innovation, since they very rarely remain completely static. The importance of good communication and efficient market intelligence are highlighted as well. Moreover, integration of the

marketing and development functions are necessary throughout the innovation. Innovation is a multi-functional process, and success is neither attributable to nor attainable through a single or a few isolated factors.

Calantone, Schmidt and Song (1996) have provided managerlal guidelines for new product success. They advise building appropriate new product development resources and expertise. Adequate marketing research, a decent sales force, distribution, advertising, and promotional resources and skills are among the conditions for conducting market assessment studies, testing products, and introducing products successfully. Their results have also indicated that greater proficiency in marketing and technical activities increases the likelihood of success for new products. Collecting and assessing information on the market and the competition contribute to a better understanding of these areas.

Cross-functional integration and competitive product advantage are two key determinants for new product success (Song and Parry, 1997). Cross-functional integration is a collective term for the integration between R&D and manufacturing, between marketing and R&D and between marketing and manufacturing. This integration means that an early understanding of market needs, desires, and behavior is essential for new product success.

Maidique and Zirger (1984) listed the following areas as being important for a new product's success: market knowledge gained through dealing with customers, planning of the new product process, marketing, management support, contribution margin of the product, early market entry, and compatibility of the new product technologies and markets with the developing organization's current strengths.

Dwyer (1990) investigated the impact of various elements of the firm's intemal situation on the proficiency of product innovation management and outlined the systems for better management of product innovation.

Edgett, Shipley and Forbes (1992) compared the success of new product innovations at Japanese and British firms. They concluded that Japanese firms outperform British ones only marginally. The main reason for the outperfonnance is that the Japanese firms place greater emphasis on meeting consumer needs by ensuring reliable, quality products at competitive prices.

Song and Parry (1994) identified six dimensions as significant correlates of new product success: market potential and marketing proficiency, competitive intensity and relative lack of product advantage, production start-up proficiency, perceived risk, market determinateness, and technical synergy and proficiency. Market potential reflected the intensity of customer need for the product, market size, and the growth rate. The protïciency of marketing activities depended on the firm's understanding of customer needs, buyer behavior, and the competitive situation, as well as on whether the firm canied out the preliminary market assessment, the prototype test with customers, the test market, and the market launch. The second dimension indicated intense competition and

scarcity of advantages over existing products. Product start-up proficiency meant adequate financial resources, thorough preparation for the launch and production of sufficient volume to satisfy demand. Perceived risk was interpreted as accurate risk perception. Market determinateness reflected the degree to which the product was clearly specified by the marketplace. Finally, technical synergy and proficiency conveyed the firm's engineering, R&D, and managerial skills, as well as proficiency in preliminary technical assessment and prototype tests.

Dwyer and Mellor (1991) observed links between the firm's organizational characteristics on the one hand and new product process activities on the other hand and also between proficiency in activity and new product project outcomes. Of all organizational elements, skills have a particularly strong impact on proficiency in activity. The second outcome has important implications for management and supports the importance of pre-development activities in the new product process.

Heracleous (1998) stressed the importance of human resource development as a driving force behind innovation. The world's most admired companies consistently invest heavily in their human resources. Leadership is crucial in orchestrating both individual career development and the appropriate organizational architecture. People are thus the crucial success factor, with information technology as a supportive element.

Hatch and Mowery (1998) have found that dedicated process development facilities, geographic proximity between development and manufacturing facilities, and the duplication of equipment between development and manufacturing facilities are all significant for improving performance in introducing new technologies. Improvement of manufacturing performance is influenced primarily by the systematic allocation of engineering labor to problem-solving activities. Furthermore, the characteristics of learning for new processes reflect significant differences between the environments within which new processes are developcd. Individual performance in new process introduction is also amenable to managerial actions. Careful management of new process introductions is very important,

Individual capacity to transform circumstances as desired depends on the application of personal and organizational resources to negotiate appropriate meanings through social and political relations with relevant parties. This element is important in the framework for understanding the construction of innovation (Coopey, Keegan, and Emler 1998).

Pickard (1996) showed the importance of an innovative culture and environment in which people feel empowered to take rlsks. In this culture and environment, freedom, support for ideas, time for experimentation, trust, and dynamism are very important.

2.2 SMEs and Innovation

SMEs provide a surprising engine of innovative activity (Thurik, 1996). Nooteboom (1994) speaks of dynamic complementarity in innovation between small businesses and large ones. Small businesses are strong in inventions aimed at applications of basic technologies, in ventures intended to develop inventions and to implement and introduce the results, and satisfaction of demand in small niches or residual markets. Large businesses, however, are skilled at fundamental research and invention and efficient production and distribution, thereby benefiting from economies of scale and scope. The qualities of small businesses are related to their core characteristics: independence and personality. These characteristics are inevitably associated with the personality of the entrepreneur.

Huiban and Bouhsina (1998) stressed the importance of labor quality in the innovation process. Small firms appeared to be less innovative for two reasons. First, they lacked economies of scale. Second, quality of manpower is important in the innovation process, especially the internal job structure and the lack of formal scholarly capabilities. Not every phase of innovation entails the same job categories.

Karlsson and Olsson (1998) added the regional environment as a potential explanatory factor behind the success of innovation by SMEs. Their hypothesis, however, was rejected: SMEs are no more dependent on their regional surroundings than large enterprises are.

Heunks (1998) showed – in the context of innovation - that proper management of a business depends on taking advantage of opportunities rather than on the intrinsic desire to run a firm. Furthermore, a certain combination of order, flexibility and creativity fosters innovation. These are typical entmpreneurial aspects. Size correlated positively with innovation, whereas firm age did not.

Quinn (1985) mentioned that large companies stay innovative by behaving like small entrepreneurial ventures. Small companies are prolific innovators for various reasons. One reason is that innovation occurs in a probabilistic setting: a company never knows whether a certain result will yield success in the market. For every new solution that succeeds, many others fail. These risks may be intolerable for big companies, as they jeopardize employment. Quinn mentions the following entrepreneurial factors as being crucial to the success of innovative small companies:

1. Need orientations: clients should be involved in an early stage.
2. Experts and fanatics: commitment is an absolute requirement for success.
3. Long-term horizons: the obstacles and length of time required to succeed should not be underestimated.
4. Low early costs: if one approach fails, little time or money is lost.
5. Multiple approaches: technology tends to advance through a series of random insights that can be tolerated only by deeply committed entrepreneurs.

6. Flexibility and quickness: undeterred by committees, board approvals and other bureaucratic delays, the entrepreneur can experiment, test, recycle, and try again with little idle time.
7. Incentives: entrepreneurs can foresee personal rewards if they are successful.
8. Availability of capital: financing institutions focus on aspects such as the people requesting funding.

3. Research questions

Based on this literature review, we have identified 13 critical success factors for the innovation process in Table 1. The classification is questionable in some respects, however, since most items are not mutually exclusive. In fact, most are strongly interrelated. The product itself and the management by the people involved are most frequently mentioned as crucial for the innovation's success, followed by the relation to the market and the innovation project's organization. Then come the surrounding market, the relationship of the company concemed to the new product, the activities preceding the actual development, technology, competition, the entrepreneur (both references from the section *SMEs and Innovation*), and, finally, the approach to the innovation project, the innovation culture within the company, and the financing of the innovation process.

Table 1. Critical Success Factors in the Innovation Process: Literature Review

1. Unique Product Advantages	Montoya-Weiss and Calantone (1994) Zirger and Maidique (1990) Cooper and Kleinschmidt (1987) Atuahene-Gima (1996) Cooper (1990) Rothwell *et* al. (1974) song and Parry (1997) Edgett, Shipley and Forbes (1992)
2. Human Resource Management	Craig and Hart (1992) Atuahene-Gima (1996) Cooper (1990) Dwyer and Mellor (1991) Heracleous (1998) Hatch and Mowery (1998) Coopey, Keegan and Emler (1998) Huiban and Bouhsina (1998)
3. Marketing Activities	Montoya-Weiss and Calantone (1994) Rothwell *et al.* (1974) Calantone, khmidt and Song (1996) Song and Parry (1997) Maidique and Zirger (1984) Edgett, Shipley and Forbes (1992) Song and Parry (1994)
4. Project Definition (advance)	Cooper and Kleinschmidt (1987) Craig and Hart (1992) Cooper (1990) Rothwell *et al.* (1974) Maidique and Zirger (1984) Song and Parry (1994)
5. Market	Zirger and Maidique (1990) Yap and Souder (1994 Calantone, Schmidt and Song (1996) Song and Parry (1994)

6. Product-Company Fit	Zirger and Maidique (1990) Yap and Souder (1994) Maidique and Zirger (1984) Song and Parry (1994)
7. Pre-Development	Cooper and Kleinschmidt (1987) Cooper (1990) Dwyer and Mellor (1991)
8. Technological Activities	Montoya-Weiss and Calantone (1994) Calantone, Schmidt and Song (1996)
9. Competition	Calantone, Schmidt and Song (1996) Song and Parry (1994)
10. Entrepreneur	Heunks (1998) Quinn (1985)
11. Project Approach	Zirger and Maidique (1990)
12. Innovation Culture	Pickard (1996)
13. Financial Means	Maidique and Zirger (1984)

Collaboration was an additional item. Many recent studies have highlighted the importance of collaboration for business success of SMEs from various perspectives. See e.g. Galbraith (1980) and Stem, El-Ansary, and Coughlan (1996).
These items were all presented to the respondents, together with the question as to whether tbey agreed that this factor was crucial in the innovation process. The respective values were measured for the different detenninants. The other factors investigated included the importance of the product or service's distinctive quality, of the mspondent's being an entrepreneur, and, finally, of the scale of the enterprise.

4. Operationaliition

Based on both the literature studied and the interviews with experts, the critical success factors were operationalized (see Table 2). The uniqueness of the product is related not only to its intemal aspects but also to the market (i.e. price). Management of human resources is measured by the current knowledge and attitude and as an opportunity for knowledge cultivation. Relationship with the client is an important aspect of marketing, as is the strength of the distribution channels and the typical promotional activities. Project definition entails thinking about both the product and the client beforehand. The market characteristics are trivial. The product-company fit is determined in terms of input, throughput, and output. Pre-development is related to the advance project definition and is both output-related and input-related. The technological activities include obtaining the right knowledge and achieving the right organization. Protection is one particular aspect of competition, in addition to the more trivial degree of competition and the novelty of the product involved. The entrepreneurial qualities enclose both attitude and activities. The success of the project approach has to do with people and organization. Innovation culture justifies the support for new ideas and activities. Funding for the innovation project may be raised intemally (e.g. through reserves) or extemally (e.g. through banks). Finally, the collaboration issue merits consideration, in terms of other companies, knowledge centers and consultants.

Table 2. Critical Success Factors in the Innovation Process: Operationalization

1. Unique Product Advantages	Product Quality Product Functions Quality/Price Relation Design
2. Human Resource Management Technological Knowledge	Marketing Knowledge Customer Orientation Training and Development
3. Marketing Activities	Testing Prototype Provision of Additional Services Strength of Distribution Channels Advertising and Promotion Sales Department
4. Project Definition (advance)	Specification of Target Group Positioning Product Product Functions Technical Product Specifications
5. Market	Size Growth Potential
6. Product-Company Fit	Relation with Current Assortment Relation with Current Clients Relation with Current Technological Knowledge
7. Pre-Development	Determination Client Wishes and Demands Competition Analysis Technical Feasibility Financial Feasibility
8. Technological Activities	Assembling Technological Knowledge Development Prototype Internal Testing Prototype Organization Production Process
9. Competition	Degree Novelty of the New Product Possibility for Patents
10. Entrepreneur	Commitment and Determination Persistence in Problem Solving Creativity Team Spirit and Motivational Capacities
11. Project Approach	Strength of Project Leader Planning and Organization Progress Checking Multidisciplinary Composition of Project Team
12. Innovation Culture	Opportunity to Air Innovative Opinions Space to Elaborate Innovative Ideas Support for Innovative Ideas
13. Financial Means	Internal Disposability External Disposability
14. Collaboration	With Other Companies With Knowledge Centers Involvement of Consultants

5. Data Collection

Initially, 638 companies were selected from the Dutch MarktSelect CD-Rom (which comprised over 800,000 organizations). The sole crlterion applied was being part of the smal1 and medium-sized sector (i.e. less than 100 employees). The selection consisted of 388 companies in the service sector and 250 in the manufacturing sector. In addition to these 638 companies, 322 others were selected from a rather subjective database. These latter companies were known for their involvement in product development. Given the smal1 size of the sample and its partially subjective nature, the selection may not have been fully representative. Nevertheless, the process occurred at random.

Thus, 960 companies were selected. Within this group 167 (17.4 percent) returned the completed questionnaire on time. Among these companies, 43.8 percent employed not more than seven employees and 49.3 percent between seven and 100; the workforce at the remaining 6.9 percent exceeded 100 people. Among the respondents, 68.3 percent consisted of the entrepreneurs themselves; the rest were mainly managers. Altogether, 47.3% of the respondents were active in the manufacturing sector, 27.5% in the service sector, and 25.2 % in other sectors.

An extensive structured questionnaire was drafted, containing general questions, questions about innovation and questions about critical success factors. The first cluster of questions conveyed the profile of the firms and the individual respondents. The questions concemed the respondent's position, the year the firm was established, the number of full-time and part-time employees, the core business and the firm's market.

The second cluster of questions addressed the type of experience of the companies with innovations. The companies indicated whether their innovations were product or service innovations, the respective numbers of product and service innovations, the market and success for the new product or service, and the extent to which the new product or service was innovative (totally new, an improved version of an existing product service or a new market for an existing product or service).

The final cluster of questions asked the respondents for their opinions about the importance of the fourteen different critical success factors mentioned in the previous section. Each critical success factor was covered by several operational questions. For instance, the critical success factor "uniqueness of product/service" can be measured by the operational questions about "uniqueness of quality", "uniqueness of product functions", "uniqueness of quality-price ratio", and "uniqueness of design" (see Table 2). The various operational questions corresponding to a critical success factor represented different aspects of that factor. This design of the questionnaire yielded a comprehensive impression of each critical factor.

The opinions of the respondents about the operational aspects were all measured on a tïve-point Lickert scale (five categories). Category 1 indicated total disagreement with a statement, whereas Category 5 corresponded with complete agreement, as answers to the

question of whether the success of a new product depended strongly on this operational aspect. The remaining answers were "disagree," "no opinion," and "agree."

6. Testing

In order to compare the importance of the different critical success factors, we had to define a factor analysis model for each critical success factor (see Lewis-Beek, 1994). Such a model assumes that the measured variables (i.e. operational questions) can be generated and represented by just one unobserved common variable known as a factor. The measurements of the observed variables were believed to contain a margin of error. Thus, the factor models are basically measurement models for the unobserved common factors (i.e. the newly defined critical success factors).

SPSS software was used to obtain Maximum Likelihood estimates of the unknown factor analysis coefficients. The percentages (R^2 values) of the operational variables, which are explained by the common factors, provided a good indication of the quality of the factor analysis models. The factor analysis models fit well in this study (nearly all R^2 values are approximately 90%). This means that each common factor is a good representation of the corresponding group of measured operational variables.

The estimates for the unknown coefficients of the fourteen factor analysis models and the scores of all the operational questions enabled US to estimate each company's scores for the common factors of the fourteen separate factor analysis models (see Lewis-Beek, 1994). In every case, these estimates of the common factors are good indicators of the values of the critical success factors.

Next, we compared the values of the different critical success factors for each company. Tables 3 and 4 depict the mean values for the critical success factors for the complete set of data, the manufacturing sector and the service sector, respectively. The critical factors were ranked in decreasing order of importance. The top of the tables lists the factor with the highest mean score and the bottom of the tables the factor with the lowest mean score. Table 5 contains analogous mean scores for entrepreneurs and nonentrepreneurs. Furthermore, Table 6 presents the mean scores for the real innovative firms and the less innovative firms. Finally, Table 7 indicates the mean scores for firms of different sizes (large vs. small).

Table 3. Determinants of Innovation Success

Critical Success Factor	*mean score*	*t-value for difference between current and next mean*	*probability level for difference between current and next mean*
Entrepreneur	4.34	4.59	0.000*
Unique Product Advantages	4.11	0.36	0.722
Innovation Culture	4.09	0.89	0.375
Project Approach	4.05	1.48	0.140

Technological Activities	3.99	0.12	0.907
Human Resource Management	3.99	0.80	0.424
Marketing Activities	3.95	0.25	0.800
Project Definition (advance)	3.94	0.05	0.962
Pre-Development	3.93	1.68	0.0%"
Market	3.82	1.43	0.153
Financial Means	3.71	3.53	0.001*
Competition	3.46	0.87	0.3%
Product-Company Fit	3.38	1.30	0.197
Collaboration	3.30		

' significant on a 0.05 level
** significant on a 0.10 level

Table 4. Determinants of Innovation Success: Service Sector vs. Manufacturing Sector

Critical Success Factor	*mean score manu-facturing sector*	*mean score service sector*	*t-value for difference between sectors*	*probability level for difference between sectors*
Entrepreneur	4.33	4.35	-0.20	0.839
Unique Product Advantages	4.19	4.00	2.26	0.025'
Innovation Culture	4.13	4.01	1.05	0.2%
Project Approach	4.05	4.05	0.03	0.980
Technological Activities	4.04	3.88	1.39	0.167
Human Re- Management	3.99	3.98	0.11	0.917
Marketing Activities	4.05	3.53	2.21	0.029'
Project Definition (advance)	3.99	3.84	1.51	0.134
Pre-Development	4.02	3.72	3.16	0.002*
Market	3.84	3.77	0.53	0.594
Financial Means	3.74	3.60	1.10	0.274
Competition	3.54	3.25	2.15	0.033'
Product-Company Fit	3.41	3.38	0.26	0.794
Collaboration	3.38	3.08	2.22	0.028'

* significant on a 0.05 kvel

Table 5. Determinants of Innovation Success: Entrepreneurs vs. Non-Entrepreneurs

Critical Success Factor	*mean score entre-preneurs*	*mean score non-entre-preneurs*	*t-value for difference between respondents*	*probability level for difference between respondents*
Entrepreneur	4.35	4.30	056	0.577
Unique Product Advantages	4.12	4.13	-0.99	0.922
Innovation Culture	4.11	4.13	-0.24	0.812
Project Approach	4.01	4.01	0.28	0.777
Technological Activities	4.05	3.94	0.93	0.355
Human Resource Management	4.00	4.00	0.05	0.963
Marketing Activities	3.93	4.07	-1.73	0.086
Project Definition (advance)	3.97	3.95	0.20	0.841
Pre-development	3.91	4.02	-1.18	0.241
Market	3.84	3.75	0.68	0.499
Financial Means	3.13	3.62	0.90	0.369
Competition	3.43	3.57	1.05	0.294
Product-Company Fit	3.46	3.27	1.50	0.137
Collaboration	3.29	3.33	-0.321	0.749

' significant on a 0.05 level

Table 6. Determinants of Innovation Success: Real Innovative vs. Less Innovative Companies

Critical Success Factor	*mean score real innovative companies*	*mean score less innovative companies*	*t-value for difference between real innovative and less innovative companies*	*probability level for difference between real innovative and less innovative companies*
Entrepreneur	4.34	4.34	0.10	0.493
Unique Product Advantages	4.14	4.08	1.20	0.186
Innovation Culture	4.08	4.10	-0.44	0.563
Project Approach	4.06	4.04	1.00	0.210
Technological Activities	3.99	4.00	-0.25	0.537
Human Resource Management	3.99	3.99	0.07	0.49
Marketing Activities	4.10	3.91	2.30	0.039
Project Definition (advance)	3.94	3.95	-0.87	0.593
Pre-Development	4.08	3.88	2.80	0.027'
Mark.24	3.84	3.80	0.93	0.364
Financial Means	3.71	3.72	-0.55	0.584
Competition	3.46	3.46	0.27	0.46
Product-Company Fit	3.31	3.39	-0.97	0.693
Collaboration	3.30	3.30	-0.12	0.505

' significant on a 0.05 level

Table 7. Determinants of Innovation Success: Large vs. Small Companies

Critical Success Factor	*mean score large companies*	*mean score small companies*	*t-value for difference between large and small companies*	*probability level for difference between large and small companies*
Entrepreneur	4.31	4.38	-0.83	0.407
Unique Product Advantages	4.07	4.10	-0.37	0.711
Innovation Culture	3.99	4.24	-2.58	0.011'
Project Approach	4.04	4.00	0.48	0.631
Technological Activities	3.99	4.02	-0.25	0.803
Human Resource Management	4.02	3.91	1.32	0.189
Marketing Activities	3.85	4.14	-3.31	0.001'
Project Definition (advance)	3.99	3.89	1.11	0.269
Pre-Development	3.91	3.91	0.02	0.983
Market	3.81	3.75	0.43	0.665
Financial Means	3.75	3.68	0.55	0.582
Competition	3.48	3.41	0.52	0.602
Product-Company Fit	3.52	3.24	2.03	0.021'
Collaboration	3.23	3.37	-1.12	0.266

significant on a 0.05 level

7. Discussion

First we will discuss the results for the complete set of data (see Table 3). Clearly, the entrepreneur is the most important factor in the innovation process. The unique product advantages, presence of an innovation culture, project approach, technological activities, human resource management, marketing activities, advance project definition and pre-development are more important than the market and financial means. The potential determinants competition, product-company fit, and collaboration are of very little influence.

Using a t-test for paired samples (see Moore and McCabe, 1993), we tested whether the mean scores for two critical success factors differ significantly. The last column of Table 3 shows which different critical success factors do indeed have different mean scores statistically on a five or ten percent significance level.

A lot of differences are apparent with respect to the sequence we observed from the literature survey. Entrepreneurs attribute remarkable importance to innovation culture and project approach. As the classification based on the literature review is rather flexible, we did not consider the differences from the perception of the respondents any further.

Next, we compared the results for the manufacturing and service sectors (see Table 4). Running a t-test for independent samples reveals that unique product advantages, marketing activities, pre-development, competition and collaboration have statistically higher preferences for products than for services (on a five percent level). In both cases the entrepreneur is the most important, while collaboration seems to have the lowest priority. This conclusion agrees witb the results for the complete set of data and partially confirms Atuahene-Gima (1996).

Table 5 gives the results for the entrepreneurs and the non-entrepreneurs. Their opinions hardly deviate, which means that the entrepreneurs do not have a special bias for themselves. In both cases the entrepreneur is mentioned as the most critical success factor. The only significant difference is that the questionnaires of the non-entrepreneurs indicate a more crucial role for marketing activities than the questionnaires of the entrepreneurs (significantly higher means with a probability of 0.086 on a t-test for independent samples).

44 firms show ten or more innovations, while their innovations are qualified as successful. Table 6 presents the results for this group of firms. On top of the table we see for the real innovative firms, apart from the entrepreneur and the unique product advantages, the critical success factors marketing activities and pre-development. Again, with a t-test for independent samples we can show that these two critical success factors are more important for real innovative firms than for the other firms.

Finally the data set was divided according to companies with up to seven employees and companies with more than seven employees. This number of workers was chosen

because it is the maximum that one individual can usually manage. A larger staff necessitates additional management and organizational changes. Marketing activities and innovation culture are more crucial for small firms than for large ones. The product-company fit has the opposite role (significant at the five percent level). See Table 7. These outcomes partially confirm Yap and Souder (1994) and Nooteboom (1994).

8. Conclusions

From the perspective of the respondents, the entrepreneur is the most important factor in the innovation process. Intemal aspects dominate not only the list of success factors but also the top of the list. A cluster of intemal aspects follows the entrepreneur: unique product advantages, innovation culture, project approach, technological activities, human resource management, marketing activities, project definition and pre-development. Market, financial means, competition, product/company fit and collaboration appear only in the third and even the fourth clusters. Financial means, however, entail both intemal and extemal aspects.

A few aspects are believed to be more important for the manufacturing sector than for the service sector. These are unique product advantages, marketing activities, pre-development, competition and collaboration. The question of intangibility of services might be crucial in this respect. The novelty of an innovative service must be considered carefully and communicated to the potential client. Otherwise, competitors may win the prize. Collaboration can be an important asset in fighting this competition.

The real successful innovative firms think unique product advantages, marketing activities and pre-development are very important. These three factors can all be controlled by firms.

The subgroups of responding entrepreneurs and non-enttepreneurs revealed hardly any differences. Nor were there many significant scale differences. Marketing is less important for the entrepreneurs involved, which might be attributable to product-blindness. Economies of scale and bureaucracy might be explanatory factors for the differences between large and smal1 companies.

Statistically, we may conclude that the entrepreneurs do not consider extemal circumstances very important aspects of innovation success. They have a rather egocentric point of view, in that they place themselves and the intemal process on top (which they are in a position to influence). Extemal aspects follow much later. This attitude obviously entails a considerable risk of over-estimation.

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